Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT

M11L0160

GROUNDING

BULK CARRIER *ORSULA*
BATTURES DE GENTILLY, BÉCANCOUR, QUEBEC
15 DECEMBER 2011

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Marine Investigation Report

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Summary

On 15 December 2011, at 0910 Eastern Standard Time, the bulk carrier *Orsula* departed Contrecœur, Quebec, in ballast for Baie-Comeau, Quebec. While proceeding downbound on the St. Lawrence River under the conduct of a pilot, the vessel lost steering control and ran aground at 1329 on the Battures de Gentilly, 1.25 miles northeast of Bécancour wharf, Quebec. About 48 hours later, it was refloated on the first attempt using tugs. The vessel sustained hull damage, which required repairs. There were no injuries or pollution as a result of this occurrence.

Ce rapport est également disponible en français.

Factual Information

Particulars of the Vessel

Name of vessel	*Orsula*
IMO number	9110901
Port of registry	Majuro
Flag	Marshall Islands
Type	Bulk carrier
Gross tonnage	20 837
Length [1]	200 m
Draught	Forward: 4.18 m Aft: 6.8 m
Built	1996, Yiangnan Shipyard, Shanghai, China
Propulsion	B&W 6S50MC, 2-stroke, single-acting engine, developing 8562 kW at 127 rpm
Cargo	Ballast, 9362 metric tons
Crew	20
Registered owner	Atlant Bulkers Corp., Majuro, Marshall Islands
Manager	Atlantska Plovidba d.d., Dubrovnik, Croatia

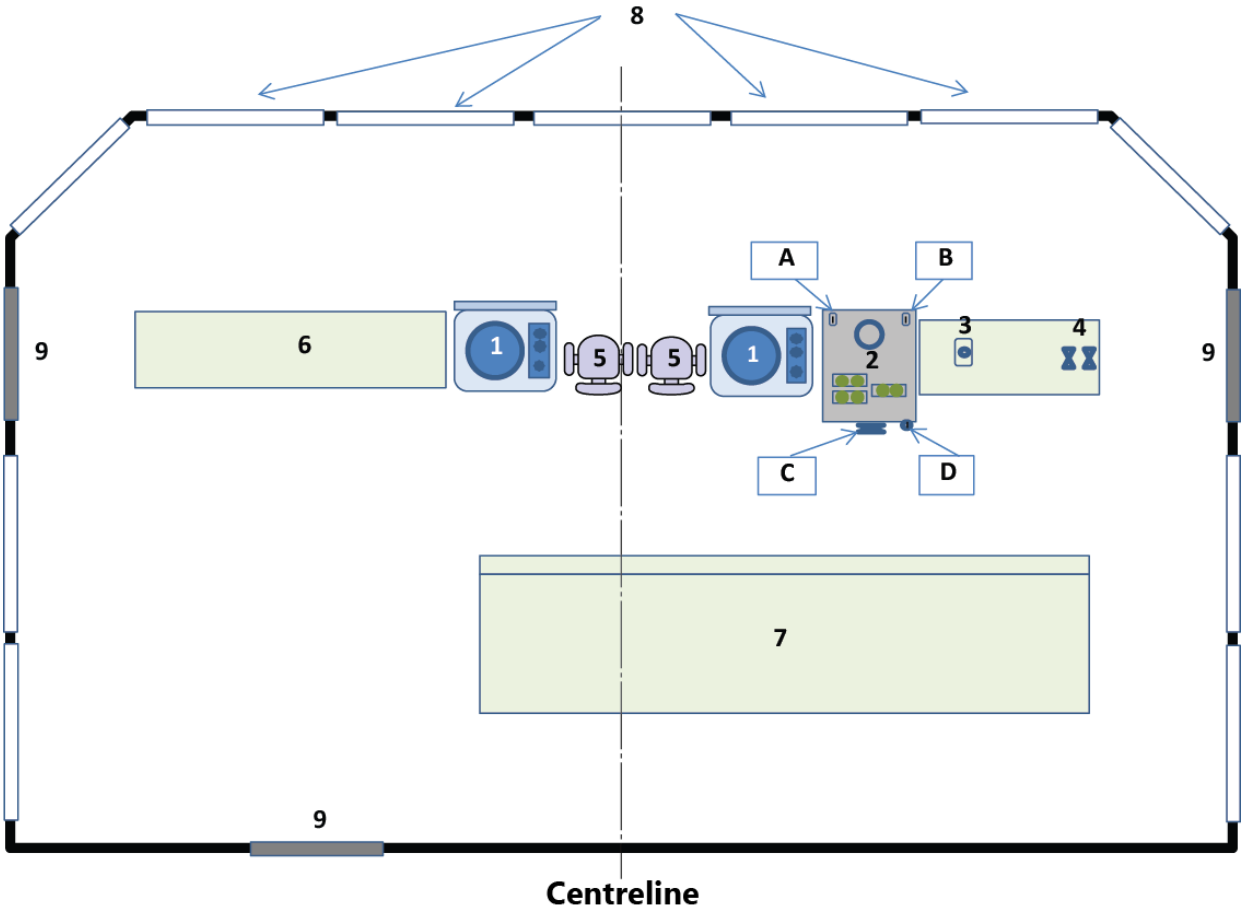
Description of the Vessel

The *Orsula* is a bulk carrier cargo vessel built of steel, with machinery spaces and accommodations located aft. The 6 cargo holds and hatches are serviced by three 30-tonne electrical-hydraulic cranes mounted on the centreline of the vessel. The bridge is equipped with all the required navigational equipment, including both 3-cm and 10-cm radars distributed on either side of the centreline (Figure 1). The steering stand is situated off to the starboard side of the centreline of the bridge, and an indication is in place at the starboard window to enable

Photo 1. *Orsula*

[1] Units of measurement in this report conform to International Maritime Organization (IMO) standards or, where there is no such standard, are expressed in the International System (SI) of units.

visual alignment with the steering light. The engine controls and the communication system are located on the starboard console.



1- Radar
2- Steering stand
3- Telegraph
4- Telephone
5- Chair
6- Navlights console
7- Chart table
8- Windows
9- Doors
A- Steering control mode
B- Telemotor control mode
C- Wheel
D- Non-follow up controller

Figure 1. Bridge layout (diagram not to scale)

History of the Voyage

On 15 December 2011, the *Orsula* departed Contrecœur, Quebec, for Baie-Comeau, Quebec, in ballast condition. At 1230, [2] the vessel arrived at the Pointe-des-Ormes pilot station. The pilot assigned from Trois-Rivières, Quebec, to Québec, Quebec, boarded the vessel, along with an apprentice pilot, to relieve the pilot assigned from Contrecœur to Trois-Rivières. At this point, a pilot-pilot exchange took place. During the exchange between the master and the new pilot, the pilot told the master that he would begin the passage at slow speed to allow sufficient time for

2 All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours) unless otherwise noted.

another vessel to manoeuvre in the port of Trois-Rivières. The pilot also informed the master of his intention to keep the engine in the manoeuvring speed mode of 12 knots through the water [3] throughout the passage to Québec. The engine control was set to bridge control. The bridge team was comprised at this time of the master, the second officer acting as officer of the watch (OOW), a pilot, an apprentice pilot, and a helmsman.

The helmsman responded well to the helm orders using the helm wheel in full follow-up (FFU) mode, and that he steered the vessel steadily. At this time, the pilot connected his portable pilot unit (PPU) and used his own global positioning system (GPS) antenna to feed the PPU. The pilot then allowed the apprentice pilot to conduct the vessel, while still supervising him. At around 1315, the vessel approached Course de Bécancour, and the apprentice altered course to 050° gyro (G) [4] to steer on the next set of ranges. At around this time, the master left the bridge.

At 1324, the vessel passed 0.4 nautical miles (nm) abeam Bécancour wharf while still in line with the ranges. At around 1326, the vessel was near buoy C21 and had reached the point at which the pilot was to initiate a turn to port. The apprentice ordered the helmsman to bring the vessel to a heading of 045°, and the helmsman confirmed this order by repeating the heading. However, the rudder angle indicator showed 10° to starboard. The apprentice then ordered the heading 045° again, and the helmsman confirmed by repeating it. With the rudder angle indicator still showing 10° to starboard, the apprentice ordered the helmsman to put the helm at midship, [5] but there was still no rudder movement showing on the rudder angle indicator.

The apprentice then advised the pilot of the situation. The pilot took over the conduct of the vessel and ordered 20° of port rudder. The rudder angle indicator remained at 10° to starboard. The pilot then ordered hard to port but, upon seeing no result, ordered 10° of starboard rudder. No rudder movement could be observed on the rudder angle indicator. The pilot then ordered the engine to be stopped, that somebody be ready to drop the anchor, and that emergency steering be activated. At this time, the vessel was more or less steady on a course of approximately 050°.

The OOW called the master and moved the engine telegraph handle from full ahead to stop, at which time the vessel's speed was approximately 15 knots speed over ground (SOG). The OOW then went and stood by the steering stand. At the same time, the pilot called Marine Communication and Traffic Services (MCTS), informing them that the vessel was out of control and would soon exit the channel. At about 0.5 nm east of buoy C21, the vessel started exiting the channel with a slow turn to starboard. The pilot ordered the main engine full astern, and the OOW set the engine telegraph to full astern. [6]

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3 Speed through the water is a measure of speed that does not take into account current or wind. On the other hand, speed over ground (SOG) accounts for the current and wind speed.

4 All courses are gyro compass headings unless otherwise specified.

5 Midship is when the rudder angle is at 0°.

6 To be able to reverse the engine and apply full astern thrust, the main engine revolutions per minute need to reach a low enough level to apply braking air in order to expedite the slowing and reversing of the engine. By the time the main engine was reversed and full astern was available, the vessel had already grounded.

At 1327, the pilot reported to MCTS that the vessel was leaving the channel and would soon ground. At approximately 1328, the master came on the bridge. He went directly to the steering stand and transferred the steering system actuator switch from port to starboard, restoring control to the steering. Nonetheless, at 1329, as the bosun and OOW were out on deck on their way to attend the anchors, the vessel ran aground at an estimated speed of 8 knots SOG. At 1331, the pilot called MCTS to report that the vessel was aground in position 46°25.4′ N and 072°21.6′ W with a heading of 079°.

Post-Occurrence Examination of Steering Stand

Following the grounding, when the vessel was towed to the Port of Bécancour, a call was made to an authorized representative of Sperry Marine to examine the bridge steering stand components. The examination determined that the port steering system helm potentiometer had failed. As part of the service call, the 3 potentiometers in the steering stand were replaced, and the system was found to be functional.

Vessel Certification

The *Orsula* carried all appropriate certificates for a vessel of its class and for the voyage. A Safety Management Certificate (SMC) had been issued to the vessel by Det Norske Veritas (DNV) in Norway on 13 November 2008 and was valid until 27 September 2013. This certificate was endorsed after an intermediate verification [7] on 06 August 2011. The vessel was thus in compliance with the requirements of the International Safety Management (ISM) Code. [8]

Crew Certification and Experience

The crew of the *Orsula* were all properly certified for their positions on board. The master held a Master Mariner certificate of competency endorsed by the Marshall Islands Maritime Administrator and had sailed as a master on various vessels belonging to the same company since 2004. He joined the *Orsula* in September 2011, having served on board as master several times since 2005.

The OOW held an Officer of the Watch certificate of competency, issued in April 2011 and endorsed by the Marshall Islands Maritime Administrator, and had been sailing on different vessels in that position since July 2011. He joined the *Orsula* on 12 December 2011.

The helmsman had been sailing since 1981 and obtained his Bridge Watchman certificate in 1987 in Croatia. He had been with this company since 2006 and joined the *Orsula* in October 2011.

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7 The SMC was subject to at least 1 intermediate verification to be carried out between the second and third anniversary dates of the SMC, in accordance with regulation IX/6.1 of the *International Convention for the Safety of Life at Sea* (SOLAS) and paragraph 13.8 of the ISM Code.

8 *International Management Code for the Safe Operation of Ships and for Pollution Prevention*

The pilot held a Master Inland Waters certificate and obtained his District 1, Class B2 pilot licence in April 2011. The apprentice pilot held a Master Near Coastal certificate and obtained his District 1, Class D apprentice licence in April 2011.

Environmental Information

On 15 December 2011, in the region of Trois-Rivières–Bécancour, the visibility was about 2 miles, and the sky was overcast with light rain. High tide was at 1351 in Trois-Rivières and at 1330 in Bécancour. The water level in Bécancour was predicted to be 1.2 m above chart datum at high tide.

Damage to the Vessel

On 17 December 2011, an underwater survey of the *Orsula* was conducted at the Port of Bécancour. The survey revealed the following:

- 2 cracks, one 1500 mm x 50 mm and the other 500 mm x 40 mm, in way of the bow thruster;
- long indents (8 m x 70 mm deep) found on the port and starboard bow;
- starboard bulkheads between the bow thruster room and forepeak tank were found buckled and detached at the bottom;
- numerous transverse floors were found buckled and detached at the bottom over a length of 1 m.

Steering Gear

The *Orsula* is equipped with an electro-hydraulic Rapson Slide (type FM21-072) steering gear with 2 rams and 4 cylinders, manufactured by Kawasaki-Wuhan. The hydraulic cylinders are supplied by 2 variable-delivery main steering gear pumps operated through a floating lever arrangement driven by a set of 2 telemotor receivers. Only 1 telemotor receiver can be used at a time, but it can drive either 1 or 2 variable-delivery main steering pumps at the same time.

In case of failure of all remote steering gear control systems, it is possible, as an emergency measure, to detach the 2 telemotor receivers from the floating lever arrangement and connect a hand trick wheel [9] to directly and manually operate the variable-delivery main steering pump. However, in order to do this, an operator must be situated locally in the steering gear compartment to operate the trick wheel and follow orders given by bridge personnel through a communication device.

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9 A wheel located in the steering gear compartment which, in an emergency, manually drives the telemotors operating the rudder

Bridge Helm Unit

The *Orsula* is fitted with a Sperry Marine steering control system (model ADG-3000). This system, fitted during the construction of the vessel and approved by the classification society, includes an all-electric helm unit that incorporates hand-steering capabilities and autopilot functions.

A steering control mode selector switch, located on the upper left-hand side of the steering stand, is used to select 1 of 3 different means of steering the vessel: autopilot, hand or non-follow-up (NFU). When the steering mode selector switch is set to the "hand" position, the helm wheel is activated, permitting the helmsman to operate the steering in FFU mode. In FFU mode, when the operator changes the position of the helm wheel, the rudder begins to move and keeps moving until it reaches the ordered position indicated on the helm. To return the rudder to the neutral (0°) position, the helm wheel must be manually positioned to 0°. The helm order data signal to the steering gear telemotors is provided by 2 potentiometers that are mechanically linked to the helm wheel and electrically linked to each telemotor: 1 potentiometer per telemotor.

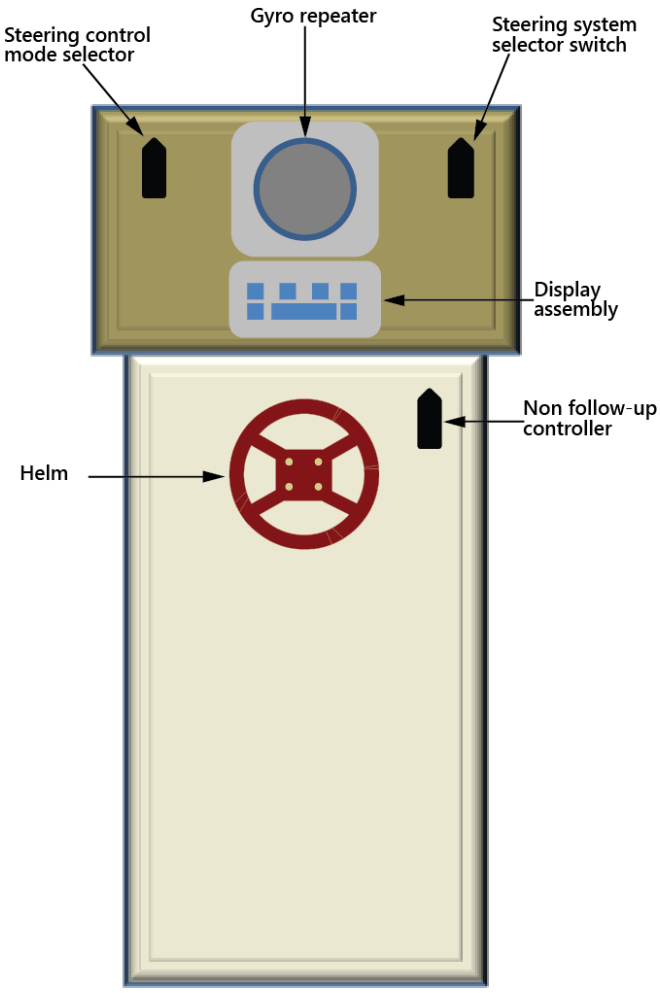

Figure 2. Bridge helm unit arrangement

Typically, when the NFU mode is selected, the NFU controller becomes operational and the helm wheel is deactivated. However, on the *Orsula*, once the NFU controller is used, it overrides all other steering controllers without the need to set the steering mode selector switch to NFU. The NFU controller is a spring-loaded lever that must be held to one side or the other for a signal to be sent to the steering gear telemotors. Operating the NFU control causes the rudder to rotate left or right for as long as the control is held in the left or right position. On releasing the control, the rudder stops rotating and holds its position until the NFU controller is again operated.

A steering system selector switch is located on the upper right-hand side of the steering helm unit. The steering selector switch selects either the port or starboard steering system. Each of these systems controls the steering gear telemotor.

Replacement of Steering Stand Components

The steering stand on the *Orsula* was manufactured by Sperry Marine. At the time of the occurrence, the steering stand instruction booklet on board the vessel, the "Sperry Helm Steering Assembly Operation and Service Manual," made no reference to the need to replace potentiometers. The manual advised the crew to perform monthly tests of the steering to verify the functioning of the potentiometer by positioning the steering wheel to one-third of a full turn, two-thirds of a full turn, and then a full turn on both sides—each time ensuring that the rudder indicator matches the wheel order.

By comparison, another manufacturer, Litton Marine, issued in 1999 the "Steering Gear Tests, Drills and Preventative Maintenance" notice for the C.Plath steering stand type, in which it recommended the replacement of potentiometers in steering stands at minimum intervals of 5 years.

Inspection of Steering Stand

On 10 December 2011, an authorized representative of Sperry-Alliance Nav visited the *Orsula* in the Port of Contrecœur at the request of the master. While the work order was to inspect the gyro, the master also requested that the technician perform a general test of the steering console. During this general test, the technician did not specifically inspect the potentiometers. The technician was aware of the recommendation from the other manufacturer to replace the potentiometer after a period of time, but found no defects on the steering console.

The potentiometer that failed on board the *Orsula* was manufactured in 1994. The potentiometer did not have any physical label to identify the manufacturing date. Instead, it was marked with a serial number that an individual could use as a reference when calling the manufacturer to determine the manufacturing date.

Laboratory Analysis

Upon examination of the potentiometer, visible contamination was found on the lower bearing, resembling a powder of a brown hue. The balls and races had been affected by some deterioration, likely due to the abrasive action of that contamination. The deterioration of the surfaces likely resulted in the need for additional force to rotate the shaft of the potentiometer, which in turn deformed and cracked the bearing cage. The examination concluded that the potentiometer did not turn freely due to the failure of its lower bearing, which had seized due to the deformation and cracking of its cage. [10]

The investigation was not able to determine the origin of the contamination.

Review of Alternative Steering Methods

The TSB conducted a review of 8 vessels from different owners and flag states in the Port of Québec to determine the general knowledge and use of the NFU mode by bridge crew members. This revealed that, on 6 out of the 8 vessels reviewed, the crew members were not

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10 TSB Laboratory report LP 180/2011, available upon request

fully familiar with the use of the NFU mode. In general, it was found that, when they first boarded the vessel, helmsmen were only given brief explanations of the different steering stand components and their use, including the NFU mode. Furthermore, the procedures for dealing with situations involving steering failures refer primarily to the local emergency steering in the steering gear compartment. Use of the NFU mode, if it is referred to, is usually listed as a secondary or tertiary method to regain control.

On the *Orsula*, 1 steering system is used to control the steering when in hand-steering mode. In the event of a steering failure, switching to another steering system can be a solution to regain control. The deficient potentiometer was linked to the port telemotor. When the master came back on the bridge, he switched the steering system selector switch from port to starboard, which restored steering control.

Reversing the Main Engine

The vessel is fitted with a direct-drive reversible low-speed engine. The engine drives 1 fixed-pitch propeller, and the vessel service speed is approximately 15 knots.

The bridge control of the engine enables a crew member to start the engine ahead or astern and choose different speed settings. To switch from ahead to astern movement, the engine must be allowed to slow down to a designated revolution (37 rpm) to prevent excessive stresses and forces before it can then be set into reverse mode and restarted astern.

When the main engine is set to full ahead (127 rpm) and the vessel speed is 14.8 knots, it takes 155 seconds for the engine to set into astern starting mode. As well, in the case of an emergency stop (putting the telegraph from full ahead to full astern), the vessel can be stopped in 5 minutes and 21 seconds. [11] This information was posted on a bulkhead in the wheelhouse.

Crew Familiarization Checklist

The managing company established different checklists to account for different aspects of safety maintenance, verification and training for the crew. Among these, form NAV09, entitled "Familiarization with Bridge Equipment," lists navigation equipment and controls to be studied and understood by the bridge crew member. When all of the items are checked off to indicate completion of familiarization, the form is signed by the crew member and the master. On the *Orsula,* this form was found to be completed and signed.

Also, form NAV10, entitled "Bridge Preparation for Departure," lists a series of verifications of bridge equipment to be completed prior to departure (Appendix C). Among these, the steering gear is to be verified in several ways.

Neither NAV09 nor NAV10 contained any information regarding the operation of the NFU mode or the option to switch from the port to the starboard steering system for steering control.

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11 Data based on information collected during sea trials of the *Orsula* prior to delivery to owner.

Drills

In Chapter V, Regulation 26 of the *International Convention for the Safety of Life at Sea* (SOLAS), there is a description of the tests and drills that must be performed on a steering gear (Appendix B). The series of verifications stated in SOLAS are the same as those in the safety management system documentation on board the *Orsula* (Appendix C). Neither is specific about the use of the NFU mode or switching from the port to the starboard steering system, or how these technical means of steering can be used in cases where steering control is lost.

Voyage Data Recorder

In addition to bridge audio, a simplified voyage data recorder (S-VDR) is capable of recording such items as time, vessel heading and speed, gyrocompass, alarms, very high frequency (VHF) radiotelephone communications, radar, echo-sounder, wind speed and direction, and rudder/engine orders and responses.

SOLAS requires that annual performance tests of the S-VDR be conducted by an approved testing or servicing facility. [12] The last annual performance test certificate on board the *Orsula* was dated 02 May 2011.

The *Orsula* had a valid safety management certificate, as required by the ISM Code; therefore, there was a safety management system on board the vessel. The safety management system included a pre-departure checklist, NAV10, which required verification of the readiness of the S-VDR. The pre-departure checklist indicated that the S-VDR had been verified by the bridge crew before leaving Contrecœur.

On the *Orsula,* the S-VDR was not recording at the time of the occurrence and had not recorded any data since May 2011. The S-VDR started recording 3 hours after the vessel went aground on 15 December 2011. [13]

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12 Regulation V/18(8)

13 TSB Laboratory Report LP182/2011, available upon request

Analysis

Events Leading to the Grounding

When the helm follow-up potentiometer of the port steering system failed, the electrical link between the steering stand and the telemotor in the steering gear compartment ceased to function, and control of rudder movement was lost. At this time, the rudder angle indicator was showing 10° to starboard. The vessel veered to starboard when it was intended to alter course to port.

When the vessel's crew members on the bridge became aware that the rudder was not responding, 3 options were available on the bridge to rectify the situation: taking over the steering control with the non-follow-up (NFU) mode, changing over from the port to the starboard steering system to also regain steering control, or stopping the vessel. However, stopping the vessel was not a viable option because of the vessel's proximity to the shore and the length of time required to put the engine at full astern and stop the vessel. Thus, while in this case the engine was ordered full astern, the engine went astern only after the vessel had grounded.

The other 2 options in this situation involved regaining control of steering. There was no attempt made by the officer of the watch (OOW) or the helmsman to use the NFU mode or to switch from the port to the starboard steering system because they were not familiar with either option. By the time the master returned to the bridge and switched the steering system selector switch from port to starboard, restoring control of rudder movement, it was too late to prevent the grounding.

Potentiometer Failure

Potentiometers send signals to a steering system amplifier and corresponding telemotors, and are mechanically connected to the helm wheel with gearwheels. As critical components of the steering gear control, potentiometers require adequate testing and record keeping to ensure that they continue to function effectively.

In this occurrence, the potentiometer connected to the port steering system failed, disrupting the link between the steering stand and the port telemotor in the steering gear compartment, resulting in the loss of control of rudder movement. The potentiometer had failed due to the consequences of contamination; however, the investigation was not able to determine the origin of this contamination.

The instruction manual for the Sperry Marine steering stand on board the *Orsula,* the "Sperry Helm Steering Assembly Operation and Service Manual," advised the crew to perform monthly verifications of the steering that would test the potentiometer. This is done by positioning the steering wheel to one-third of a full turn, two-thirds of a full turn, and then a full turn—each time ensuring that the rudder indicator matches the wheel order. While the NAV10 checklist, that contains the procedures that the crew of the *Orsula* performed before each departure, does require a steering test, this steering test does not fully correspond to the procedure stated in the manual. Referring to Appendix C, the checklist requires a steering gear test where the wheel is

turned hard over to port and hard over to starboard. Therefore, this procedure may not have adequately served to test the potentiometer in accordance with the manufacturer's instructions.

The regular testing of steering merely verifies that the potentiometer is functional at the specific time of a given test. If one of the potentiometers fails, the bridge operator can either switch to the alternate steering system or regain steering control using the NFU mode. The effectiveness of these 2 options available to the bridge operator depends on the operator's awareness of and ability to use these options in the event of a failure.

The Sperry Marine instruction manual on board the *Orsula* did not contain any reference to the need to replace potentiometers. The potentiometer that failed in this occurrence had been manufactured in 1994. Other manufacturers, such as Litton Marine, recommend that potentiometers in steering stands be replaced at minimum intervals of 5 years. Without regular replacement of potentiometers, there is an increased risk that they will fail in service.

Familiarity with Steering Control Modes

To react effectively in emergency situations where there is a loss of steering control, a crew must be aware of the means to regain that control. This is especially crucial when the vessel is sailing in restricted waters. That awareness can come from technical manuals, familiarization, drills, and posted procedures.

Steering control was lost on the *Orsula* when one of the potentiometers failed. Using the NFU mode in situations such as these is an efficient and effective way to try to regain control of the vessel's steering. Also, another effective method is to switch from the port to the starboard steering system. However, neither the helmsman nor the OOW tried the NFU mode or switched the steering systems to regain control.

The helmsman and OOW were not familiar with these methods, and they did not make use of them in this occurrence. Neither method was specifically addressed in *Orsula*'s on-board familiarization, as they were not included in the NAV09 or NAV10 checklists. There was no specific information on these methods posted near the steering stand or specified in the on-board "Sperry Helm Steering Assembly Operation and Service Manual." The procedure for emergency steering drills, in compliance with SOLAS, also did not include the testing and use of the NFU mode or switching steering systems. As such, there were limited opportunities for the bridge crew to become familiar with these 2 means of regaining steering control on board the *Orsula*.

Furthermore, the TSB's review of 8 vessels found that the lack of awareness of the NFU mode is not limited to the *Orsula* and may be an indication of a broader problem. Therefore, if information on steering control methods, such as the NFU mode or switching steering systems, is not adequately incorporated into technical manuals, familiarization, and drills, or adequately described and posted near steering stands, crew may be unfamiliar with these methods. As in the *Orsula,* a lack of familiarity with either method can put the vessel and its crew at risk when a means of regaining steering control is needed in an emergency.

Voyage Data Recorder

The purpose of a voyage data recorder (VDR) is to create and maintain a secure, retrievable record of information indicating the position, movement, physical status, and control of a vessel for the period covering the most recent 12 hours of operation. Objective data is invaluable to investigators when seeking to understand a sequence of events and identify operational problems and human factors.

The pre-departure checklist on board the *Orsula* (NAV10) indicated that the simplified voyage data recorder (S-VDR) had been verified by the bridge crew prior to departure; the crew did not see any indication that the S-VDR was malfunctioning. Furthermore, the investigation did not determine why the VDR was not recording at the time of the occurrence, nor why it had not recorded data since May 2011. The VDR started recording 3 hours after the vessel went aground on 15 December 2011.

When VDR data, in particular bridge audio recordings, are not available to an investigation, this may preclude the identification and communication of safety deficiencies to advance transportation safety.

Conclusions

Findings as to Causes and Contributing Factors

1. Steering control was lost when the port steering system potentiometer failed while the rudder angle was at 10^{o} to starboard, causing the vessel to veer to starboard and leave the dredged channel.

2. The bridge crew members were not familiar with the use of the non-follow-up mode or with switching the steering system selector switch from port to starboard to regain steering control.

3. The master switched the steering system selector switch from port to starboard, which restored steering control, but it was too late to prevent the vessel from running aground.

Findings as to Risk

1. Without the regular replacement of potentiometers, there is an increased risk that they will fail in service.

2. Crew may be unfamiliar with the steering control methods of the non-follow-up mode or switching steering systems in cases of steering failure if this information is not incorporated into technical manuals, familiarization, and drills, or adequately described and posted near the steering stand.

3. When data from the voyage data recorder, in particular the bridge audio recordings, are not available to an investigation, this may preclude the identification and communication of safety deficiencies to advance transportation safety.

Safety Action

Action Taken

TSB

On 03 January 2012, the TSB issued a Marine Safety Advisory Letter (MSA) 07/11 to the International Association of Classification Societies (IACS), a copy of which was also sent to Transport Canada, Fednav Limited (as sister vessel owners), Anglo-Eastern Ship Management (as sister vessel manager), Sperry Marine, and Det Norske Veritas (DNV), Republic of the Marshall Islands, for it to consider informing its member classification societies of the circumstances of this steering gear failure and of the necessity to replace potentiometers in similar Litton Marine System (Sperry Marine) steering systems at or before the recommended interval of 5 years. The letter also requested that IACS consider verifying that the manufacturer's service instructions are on board vessels fitted with similar systems.

Owner

After this occurrence, the owner instructed all vessels in its fleet to perform an "Emergency Steering Drill" on Sundays. During the drill, the master is to explain to all deck officers and helmsmen how to change from the follow-up to the non-follow-up steering mode. After this explanation, the crew must demonstrate these techniques to the master.

The owner also included emergency changeover arrangements for steering gear in the "Familiarization with Bridge Equipment" and "Bridge Preparation for Arrival/Departure" checklists. The understanding of these checklists should be demonstrated by all navigating officers and helmsmen during each emergency drill.

Furthermore, the owner revised the safety management system for the *Orsula* and other vessels with the same equipment to include the requirement to replace potentiometers every 5 years for preventative maintenance.

Sister Vessel Owner

On 07 February 2012, the FedNav Owned Fleet department forwarded a copy of the MSA to its technical managers, requesting that they follow up with the FedNav vessels under their management.

Lloyd's Register

On 22 February 2012, Lloyd's Register issued Classification News No. 07/2012 to all vessel owners and operators, strongly recommending that they ensure that all service bulletins are maintained up-to-date with a copy retained on board, and that necessary maintenance procedures are adhered to on steering control potentiometers.

China Classification Society

On 17 April 2012, the China Classification Society (CCS) issued Classification Information notice No. 196 to distribute the MSA to relevant shipping companies. The information has also been published on the CCS website.

International Association of Classification Societies Limited

On 06 June 2012, IACS responded to the TSB stating that it had distributed the MSA to its members and that it would officially reply to the MSA once it had received feedback.

On 02 July 2012, IACS responded to the TSB stating that it had informed individual member classifications societies of the circumstances of the steering failure. IACS considers that it is the responsibility of the manufacturer of the steering system or potentiometer to identify the vessels fitted with this equipment and to inform the concerned owners/operators of all updated instructions and recommendations for the equipment.

Marshall Islands Maritime Administrator

The Marshall Islands Maritime Administrator recommends that the operator of the *Orsula* reviews, and revises as appropriate, its procedures and checklists for documenting the familiarization of on-signing officers of the watch with the vessel's bridge equipment. It also recommends that the officer be required to demonstrate to the master and/or chief officer their ability to operate the steering gear in all modes of operation. In addition, it is recommended that these procedures include ensuring that the on-signing officer is familiar with how to respond to a steering failure when navigating in restricted waters without intervention from the master. Also, it is recommended that these familiarization requirements be included as a pre-requisite for crew members serving as helmsmen.

Furthermore, the Maritime Administrator recommends that the operator ensure that all officers of the watch and helmsmen currently serving on vessels in its managed fleet receive hands-on training, that they are able to demonstrate proper operation of the steering gear in all modes of operation, and that they are familiar with the proper response to a steering failure in restricted waters.

It is also recommended that the operator use the lessons learned from this occurrence as a case study for enhanced bridge team management training for its crews.

Safety Concerns

Familiarity with Steering Control Modes

Steering is a critical aspect of operating a vessel. Vessels that are compliant with the *International Convention for the Safety of Life at Sea* (SOLAS) are required to have at least 2 independent steering control systems, designed so that there is a built-in redundancy. In this occurrence, when the rudder did not respond, the on-watch personnel did not know why and did not select the alternate steering system. A quick response would have allowed the vessel to regain steering control before it departed the channel and grounded. As such, familiarity with and use

of these steering systems is of the utmost importance in situations where a steering system fails and there is limited time available to regain steering control.

SOLAS Chapter V, Regulation 26 states the following: "all ships' officers concerned with the operation and/or maintenance of steering gear shall be familiar with the operation of the steering systems fitted on the ship and with the procedures for changing from one system to another." The information can be conveyed through technical manuals, familiarization, drills, and posted procedures.

When the potentiometer failed on the port steering system of the *Orsula,* the use of the alternative remote steering systems on the bridge was the fastest method of regaining steering control. On the *Orsula*, the steering systems available on the bridge were as follows:

- Remote full follow-up (FFU) mode using the helm wheel on the port steering system.
- Remote FFU mode using the helm wheel on the starboard steering system.
- Remote non-follow-up (NFU) mode using the hand lever.

However, the on-watch personnel were not familiar with the use of these systems and, as such, did not make use of them during this occurrence.

During the investigation, the TSB visited 8 vessels to verify the crew's familiarity with steering systems. The TSB found that the lack of awareness of alternative steering systems was not limited to the *Orsula*, which indicates a broader problem.

In the past 10 years, the TSB has recorded approximately 180 occurrences related to steering failure. While most of these did not result in groundings, steering failures nonetheless present significant risks to a vessel's operation. In one of these occurrences, involving the vessel *Fossnes* (occurrence number M00L0114), similar safety concerns as that of the occurrence involving the *Orsula* were identified.

Furthermore, the Australian Transport Safety Bureau (ATSB), in its report on the 31 July 2008 grounding of the bulk carrier *Iron King* at Port Hedland, Western Australia, identified, as a safety issue, a lack of drills and training on the procedures to be used when steering is lost. In the *Iron King* incident, the vessel's SMS procedures stated that emergency steering drills should be carried out, but did not explain how to do so.

In light of the potential hazards associated with the loss of steering control on vessels, the Board is concerned that shortcomings in the familiarization and training of crew members with regards to steering systems may result in risks to life, property, and the environment. The Board will be monitoring the situation to determine if appropriate remedial action is being taken and will assess the need for further action on this issue.

Availability of Voyage Data Recorder Data

The purpose of a voyage data recorder (VDR) is to create and maintain a secure, retrievable record of information related to the position, movement, physical status, command and control of a vessel. Objective data—voice data in particular—are invaluable to investigators seeking to

understand the sequence of events leading up to an occurrence. In this investigation, voice data recorded by VDR would have been a highly effective means of gathering information about the activities of the bridge team.

Upon reviewing past occurrences investigated by the TSB, it was determined that the failure of VDRs to function as intended is not uncommon. For example, on 31 March 2011, the VDR on the *BBC Steinhoeft* [14] was found to have ceased functioning prior to the grounding, thus making important information inaccessible to the TSB. Likewise, in other occurrence investigations (M10H0006/*Clipper Adventurer,* M09C0051/*Federal Agno*, and M05L0205/*Cast Prosperity* and tanker *Hyde Park*), the VDR data was unavailable for different reasons, which impeded the work of the TSB. In addition, numerous marine occurrence investigations worldwide have identified a similar problem regarding malfunctioning or non-operating vessel VDRs.

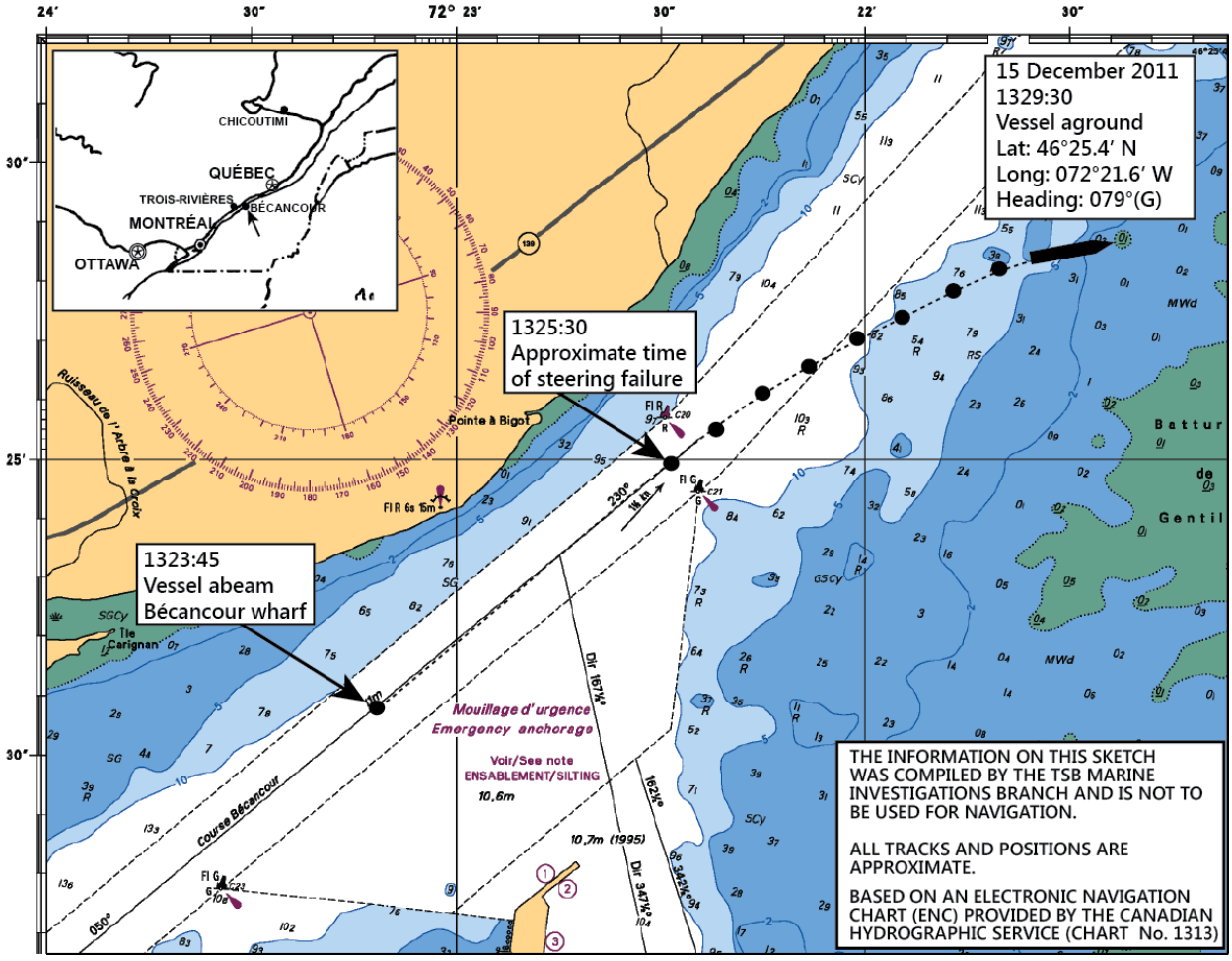
Given this history and the occurrence of the *Orsula*, the Board is concerned that when VDR data, in particular bridge audio recordings, are not available to an investigation, this may preclude the identification and communication of safety deficiencies to advance transportation safety. The Board will be monitoring the situation with a view to assessing the need for further safety action on this issue.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 23 January 2013. It was officially released on 07 February 2013.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

14 TSB Occurrence M11C0001

Appendix A – Area of the Occurrence



Appendix B – SOLAS Chapter V

REGULATION 26 - Steering Gear: Testing and Drills

1. Within 12 hours before departure, the ship's steering gear shall be checked and tested by the ship's crew. The test procedure shall include, where applicable, the operation of the following:

   .1 the main steering gear;

   .2 the auxiliary steering gear;

   .3 the remote steering gear control systems;

   .4 the steering positions located on the navigation bridge;

   .5 the emergency power supply;

   .6 the rudder angle indicators in relation to the actual position of the rudder;

   .7 the remote steering gear control system power failure alarms;

   .8 the steering gear power unit failure alarms; and

   .9 automatic isolating arrangements and other automatic equipment.

2. The checks and tests shall include:

   .1 the full movement of the rudder according to the required capabilities of the steering gear;

   .2 a visual inspection for the steering gear and its connecting linkage; and

   .3 the operation of the means of communication between the navigation bridge and steering gear compartment.

3.1. Simple operating instructions with a block diagram showing the change-over procedures for remote steering gear control systems and steering gear power units shall be permanently displayed on the navigation bridge and in the steering compartment.

3.2. All ships' officers concerned with the operation and/or maintenance of steering gear shall be familiar with the operation of the steering systems fitted on the ship and with the procedures for changing from one system to another.

4. In addition to the routine checks and tests prescribed in paragraphs 1 and 2, emergency steering drills shall take place at least once every three months in order to practice emergency steering procedures. These drills shall include direct control within the steering gear compartment, the communications procedure with the navigation bridge and, where applicable the operation of alternative power supplies.

5. The Administration may waive the requirements to carry out the checks and tests prescribed in paragraphs 1 and 2 for ships which regularly engage on voyages of short duration. Such ships shall carry out these checks and tests at least once every week.

6. The date upon which the checks and tests prescribed in paragraphs 1 and 2 are carried out and the date and details of emergency steering drills carried out under paragraph 4, shall be recorded.

Appendix C – Form Number NAV10

ATLANTSKA PLOVIDBA d.d.
Form Number: NAV10 Page 1 of 1

BRIDGE PREPARATION FOR DEPARTURE

Ship's Name:_____

		TICK
1	**HAS A PASSAGE PLAN FOR THE INTENDED VOYAGE BEEN PREPARED?**	
2	**ARE ALL RELEVANT CHARTS AND NAUTICAL PUBLICATIONS CORRECTED UP TO DATE AND COURSES LAID OFF?**	
3	**HAS THE FOLLOWING EQUIPMENT BEEN CHECKED AND FOUND READY FOR USE?**	
	• ANCHORS INCLUDING CLEARED AWAY	
	• MOORING WINCHES AND LINES INCLUDING HEAVING LINES	
	• BRIDGE MOVEMENT BOOK / COURSE AND ENGINE MOVEMENT RECORDER	
	• SIMPLIFIED VOYAGE DATA RECORDER	
	• AUTOMATIC IDENTIFICATION SYSTEM (AIS) UPDATED	
	• ECHO SOUNDER	
	• ELECTRONIC NAVIGATIONAL POSITION FIXING SYSTEMS	
	• GYRO / MAGNETIC COMPASS AND REPEATERS	
	• RADARS AND ASSOCIATED PLOTTING AIDS	
	• SPEED / DISTANCE RECORDER	
	• CLOCKS (SYNCHRONISED)	
	• BRIDGE AND ENGINE ROOM TELEGRAPHS, INCLUDING	
	- RPM INDICATORS	
	- EMERGENCY ENGINE STOPS	
	- THRUSTER CONTROLS AND INDICATORS, IF FITTED	
	• - CONTROLLABLE PITCH PROPELLER CONTROLS AND INDICATORS, IF FITTED	
	• COMMUNICATION FACILITIES - INTERNAL, EXTERNAL AND PORTABLE	
	• NAVIGATION AND SIGNAL LIGHTS / SHAPES, INCLUDING SEARCHLIGHTS, SIGNALLING LAMP, MORSE LIGHT, "NOT UNDER COMMAND" AND "AT ANCHOR"	
	• SHIP'S WHISTLE	
	• DECK LIGHTING	
	• PRESSURE ON FIRE MAIN	
	• WINDOW WIPER / CLEARVIEW SCREEN ARRANGEMENTS	
	• ANCILLARY BRIDGE EQUIPMENT (E.G. BINOCULARS, WINDOW WIPERS)	
	• STEERING GEAR TESTED INCLUDING :	
	- HARD OVER PORT - HARD OVER STARBOARD, STEERING GEAR NO. 1	
	- HARD OVER PORT - HARD OVER STARBOARD, STEERING GEAR NO. 2	
	- AUTO-PILOT	
	- TEST OF MANUAL OPERATION	
	- TEST FUNCTION OF STEERING GEAR TO BRIDGE COMMUNICATIONS	
	• - CONFIRMATION OF CORRECT FUNCTION OF RUDDER INDICATORS	
	• WATER INGRESS DETECTION SYSTEM	
	• DEWATERING SYSTEM	
4	**IS THE SHIP SECURE FOR SEA?**	
	• CARGO AND CARGO HANDLING EQUIPMENT SECURED	
	• ALL HULL OPENINGS SECURED AND WATERTIGHT	
	• CARGO / PASSENGERS DETAILS AVAILABLE	
	• STABILITY AND DRAUGHT INFORMATION AVAILABLE	
5	**ALL THE CREW ON BOARD AND ALL SHORE PERSONALL ASHORE?**	
6	**IS THE VESSEL THROUGHLY SEARCHED FOR STOWAWAYS?**	
7	**IS THE VESSEL THROUGHLY SEARCHED FOR DRUGS?**	
8	**IS THE CREW AT STATIONS FOR LEAVING HARBOUR?**	
9	**ARE THE PILOT DISEMBARKATION ARRANGEMENTS IN PLACE?**	
10	**CONFIRMATION FROM E.R. THAT CHECK LIST TEC20 IS SATISFACTORILY COMPLETED AND BRIDGE CONTROL ACCEPTED?**	

PORT..... DATE..... TIME.....

SIGNED MASTER ..... OFFICER OF WATCH .....

To be filed on board for inspection purposes.